ESTIMATED BYCATCH MORTALITY OF WINTER SKATE (*LEUCORAJA OCELLATA*) IN THE SOUTHERN GULF OF ST. LAWRENCE SCALLOP FISHERY (2006 TO 2008)

Context

Winter skate (*Leucoraja ocellata*) in the southern Gulf of St. Lawrence was designated as endangered by the Committee on the Status of Endangered Wildlife in Canada in May 2005. A recovery potential assessment (RPA) concluded that relatively elevated adult mortality was responsible for the previous and ongoing declines in abundance (DFO 2005; Swain et al. 2006a,b; 2009). There has been no directed fishery for winter skate and estimated bycatch in groundfish and shrimp fisheries has been very low. There is considerable spatial-temporal overlap between the scallop fishery and the distribution of winter skate, however, the impact of discarding in the southern Gulf of St. Lawrence scallop (*Placopecten magellanicus*) fishery on winter skate mortality could not be quantified at the time of the RPA due to a lack of information on incidental catches (Swain et al. 2006b). In response, an at-sea sampling project aboard commercial scallop fishing vessels was conducted during the 2006 to 2008 scallop fishing seasons (Benoît et al. 2010). The goal was to estimate the amount of winter skate captured in the fishery, as well as to assess the potential survival rate of discarded skate.

Subsequently, DFO Fisheries and Aquaculture Management (FAM) requested advice on the contribution of discard mortality to overall adult winter skate mortality in the southern Gulf of St. Lawrence. Specifically, FAM requested that Science, "estimate the following quantities for the southern Gulf scallop fishery, within the limits of available data: the number and biomass of juvenile and adult winter skate captured annually, the potential survival rate of discarded winter skate, and the annual exploitation rate of bycaught winter skate". FAM also requested that Science, "evaluate the estimated exploitation rate in light of other sources of mortality and evaluate the degree to which bycatch mortality in the scallop fishery may be impeding recovery".

The Special Science Response review was held on April 6, 2010. In summary, the percentage of the winter skate population killed annually in the southern Gulf of St. Lawrence scallop fishery was about 0.14% for juveniles and 0.07% for adults (Benoît et al. 2010). In contrast, the estimated percent of the population that dies annually other than from bycatch mortality in the southern Gulf scallop, groundfish and shrimp fisheries is 75% for juveniles and 34% for adults.

Analysis and Response

Details on the data sources, data treatment, and analysis used to formulate this response are available in Benoît *et al.* (2010).

A total of 624 fishing sets (average duration of a fishing set was 19 minutes) in 24 trips (1 day/trip) was observed in the commercial scallop fishery from 2006 to 2008. Samples were obtained in scallop fishing areas (SFA) 21A, 21B, 21C, 22, 23, and 24. During the at-sea sampling, individual winter skate were measured and their condition (degree of injury, on a scale of none to major, and 'liveliness', on a scale from very lively to moribund) was assessed

visually. To be consistent with the RPA, winter skate <42 cm were considered to represent the juvenile portion of the population. No winter skate were caught in 14 of 24 sampled trips and catches ranged from 1 to 4 fish in 9 of the 10 trips with winter skate catches (Fig. 1). An exceptionally high catch occurred during one trip in SFA 22 when 30 winter skate were captured over 19 fishing sets.

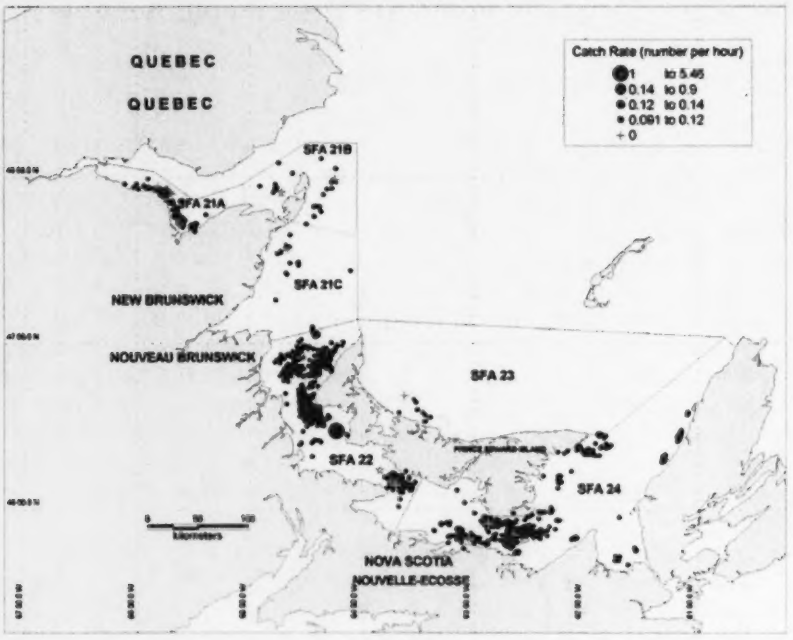

Figure 1. Location of commercial sc... ...ing trips (2006 to 2008) from fish harvesters' logbooks (black dots), location of sampled fishing trips ...u circles and crosses) and location of experimental fishing sites (yellow stars). The relative size of the ...ed circles corresponds to the winter skate catch rate (fish per hour of fishing) during individually observed commercial fishing trips, crosses indicate null catches. Solid lines delineate the six scallop fishing areas (SFA) that were sampled.

Bycatch of winter skate was also quantified as part of a 2007 research project on the impacts of scallop dredging on benthic habitats and communities, which involved experimental dredging in two areas currently closed to commercial scallop fishing. The average bycatch rate in the experimental study was 1.9 winter skate per trip and corroborates the low bycatch rate in the commercial fishery sampling. Bycatch information from the experimental study was not used in the estimation of total bycatch mortality in the commercial scallop fishery.

Most winter skate captured were in excellent condition prior to discarding. About 6% of individuals suffered major injuries, mainly involving bruising, cuts or partially torn wings. Based on the condition sampling, experiments of the short-term survival of discarded fish, and the observation that most discarded skate readily swam away from the vessel and towards the bottom, a 90% survival rate for discarded winter skate was estimated and assumed for this study (Benoît et al. 2010).

In 2006 to 2008, between 1,100 and 1,300 fishing trips were undertaken annually in SFAs 21 to 24. Based on the observed catch rates, the estimated total number of winter skate captured in

the scallop fishery in SFAs 21 to 24 was 3,779 (701 to 5,793, 95% Confidence Interval) in 2006, 3,830 (703 to 5,810) in 2007 and 3,392 (590 to 4,876) in 2008. These estimates correspond to an average bycatch rate of 3.0 winter skate per trip in the fishery. Approximately 82% of winter skate captured in the scallop fishery would be considered juveniles.

The numbers of winter skate caught in the scallop fishery in the southern Gulf were estimated based on the capture rate of winter skate in the SFAs 21 to 24. In 2006 to 2008, between 1,400 and 1,700 annual trips were recorded in the entire southern Gulf of St. Lawrence. Scallop fishing trips that occur outside SFAs 21 to 24 (e.g., northern shore of Baie des Chaleurs) represent about 21.8% of the total fishing trips in the southern Gulf. Based on a 90% survival rate, the number of winter skate killed in the 2007 southern Gulf scallop fishery (the year with the highest mean catches in the study) was estimated to have been 402 juveniles (73 to 600, 95% confidence Interval) and 88 adults (16 to 132).

The mean number of winter skate in the population in 2007, estimated using the model of Swain et al. (2009), was 274,700 juveniles (60,800 to 793,400, 95% credibility interval) and 205,151 adults (111,600 to 355,200). Using the upper confidence interval for the number of juvenile and adult winter skate killed in the scallop fishery that year gives an estimated exploitation rate (percent removed) in 2007 of 0.22% for juveniles and 0.06% for adults. Estimated in this manner, the average annual exploitation rates for the 2006 to 2008 period were 0.14% for juveniles and 0.07% for adults. Maximum annual exploitation rates for the period 2006 to 2008, based on the lower credibility interval of the estimated abundance of juveniles and adults and the upper confidence interval for mortality in the scallop fishery, were 0.69% for juvenile and 0.13% for adult winter skate.

Table 1. Estimated annual mean number of winter skate that die (mean and 95% confidence interval), population abundance (mean and 95% credibility interval) and exploitation rate for juvenile and adult winter skate in the southern Gulf of St. Lawrence, 2006 to 2008. Two estimates of exploitation rate are presented based on the ratio of the upper confidence interval for the bycatch losses of juvenile and adult winter and either i) the mean estimated population abundance or ii) the lower credibility interval of the estimated population abundance.

	Year		
	2006	2007	2008
Juveniles			
Bycatch loss (numbers)	396 (73-607)	402 (74-600)	356 (62-511)
Abundance (thousands)	612 (116-1,687)	275 (61-793)	311 (73-802)
Exploitation rate i)	0.10%	0.22%	0.16%
ii)	0.52%	0.99%	0.70%
Adults			
Bycatch loss (numbers)	87 (16-133)	88 (16-132)	78 (13-112)
Abundance (thousands)	179 (86-328)	205 (112-355)	174 (87-310)
Exploitation rate i)	0.07%	0.06%	0.06%
ii)	0.16%	0.12%	0.13%

The natural mortality rate of winter skate (i.e., mortality that excludes losses due to bycatch in the scallop, groundfish and shrimp fisheries) in 2007, estimated using the model of Swain et al. (2009) and expressed as a percent of abundance, was 75% for juveniles and 34% for adults. The level of bycatch mortality of both juvenile and adult winter skate in the southern Gulf scallop fishery is therefore very small relative to natural mortality.

Conclusions

The estimated number of winter skate captured annually in the scallop fishery during the 2006 to 2008 fishing seasons was very small relative to the estimated total population size. Furthermore, the survival rate for discarded winter skate appeared relatively high. Consequently fishing-induced mortality of juvenile and adult winter skate in the scallop fishery is estimated to be a very small percentage of total mortality (estimated at <0.2%, though perhaps as high as 1%). Due to past changes in the scallop fishery, such as gear modifications and the introduction of areas closed to fishing, it is not possible to use the results of the 2006 to 2008 at-sea sampling study to evaluate the contribution of mortality in the scallop fishery to total mortality in prior years (Benoît et al. 2010).

The analyses in this study incorporated different sources of uncertainty affecting the estimates of winter skate bycatch, and compensated or adjusted for certain sources of bias. Nonetheless some known potential sources of bias remained, including non-random sampling of fishing activities, observer effects on harvester fishing and handling practices (e.g., Benoît and Allard 2009), and potential under-reporting of fishing activities by harvesters. While the potential biases could certainly affect the results of the analysis, it is unlikely that their effect would be so important as to increase the estimated number of captured winter skate by the roughly two orders of magnitude required to make the bycatch fishing mortality an important component of total mortality.

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Date
June 16, 2010

Sources of information

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ISSN 1919-3750 (Print)
ISSN 1919-3769 (Online)
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La version française est disponible à l'adresse ci-dessus.

Correct citation for this publication:

DFO. 2010. Estimated bycatch mortality of winter skate (*Leucoraja ocellata*) in the southern Gulf of St. Lawrence scallop fishery (2006 to 2008). DFO Can. Sci. Advis. Sec. Sci. Resp. 2010/009.